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# The Jamaican Filmy Ferns

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The students who have been working for many years to unravel the history of the vegetable kingdom, have given us a very clear and convincing body of proof that our terrestrial plants have developed from aquatic ancestors. It is doubtful if any single event in plant evolution is of greater importance than the emergence from ponds, rivers and lakes, and the development of characteristics which make life possible on dry land. We are familiar with the necessity of water for fertilization in mosses and in the prothallia of ferns, and the fact is very impressive when we realize that none of the ancestors of these plants were ever free of dependence upon water or films of water for this critical act in their life histories. The emergence of plants from the water to the land may have occurred more than once and in more than one group. However this may be, we have numerous cases in which members of purely terrestrial groups have returned to the water. All of our aquatic flowering plants show their terrestrial origin both in their relationships and in the fact that they expose their flowers above water, where fertilization is able to take place by the complex process of pollination which, more than any other performance or structure, was the thing that made terrestrial existence possible.

Although ferns still depend upon water as the medium for the transfer of sperm to egg, this act may be per-

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formed with a scanty and transitory supply of water. So far as all the vegetative functions of root and leaf are concerned, the ferns have developed capabilities for living in moderately dry places as well as in extremely arid situations in company with cacti and thorny leafless shrubs. Just one family of ferns, the *Hymenophyllaceae*, have retained or acquired characteristics which make abundant water just as essential to the every-day vegetative processes of their leaves as it is to the sperms at the critical moment of fertilization. A microscopic examination of the leaves of filmy ferns would reveal the nature of their water requirements, even if it were not possible to observe the plants in their natural habitats. Their delicate fronds are found to be only one cell in thickness. There is no upper or lower epidermis, no central tissue traversed by water vessels and honeycombed by intercellular air spaces, and there are no stomata to connect internal air cavities with the outside. All these features of the normal aerial leaf are replaced by a structure as simple as that of the smaller algae. The frond of the filmy ferns is, of course, provided with vessels, and they branch to each pinnule, but there are often as many as fifteen cells between the vein and the margin of the pinnule. It is plain that such leaves depend little upon the water that is conveyed to them by the vessels and rely largely upon their direct contact with a surface film of water.

There are relatively few localities in the world where the climatic conditions are favorable to the existence of plants which demand a sustained supply of atmospheric water. The mountainous tropical islands of the world offer these conditions, and so do the most moist elevations of continental mountains at low latitudes. During the course of three extended visits to Jamaica the writer has had an opportunity to observe and study the filmy ferns in one of the localities where they reach

a splendid development in number of species and wealth of individuals. The exacting moisture requirements of these plants are met in the shady floor of the lowland forests, while in the rainy fog-filled forests of the mountains the moisture is great enough to permit filmy ferns to grow above the floor of the forest both as climbers and as epiphytes. Among the Jamaican *Hymenophyllaceae* we find a diversity of habit, structure and habitat, in spite of the specialized character of the group. A set of 26 species communicated to the writer by Prof. Giesenhagen, from Ceylon and Java, show no such structural variety, and give no hint of such diversity of habitat as do the Jamaican plants under consideration. Forty-nine species of filmy ferns have been described from Jamaican material, but some of these are extremely rare, while others are of doubtful validity. The writer was able to find only 33 species, 18 of *Trichomanes* and 15 of *Hymenophyllum*.

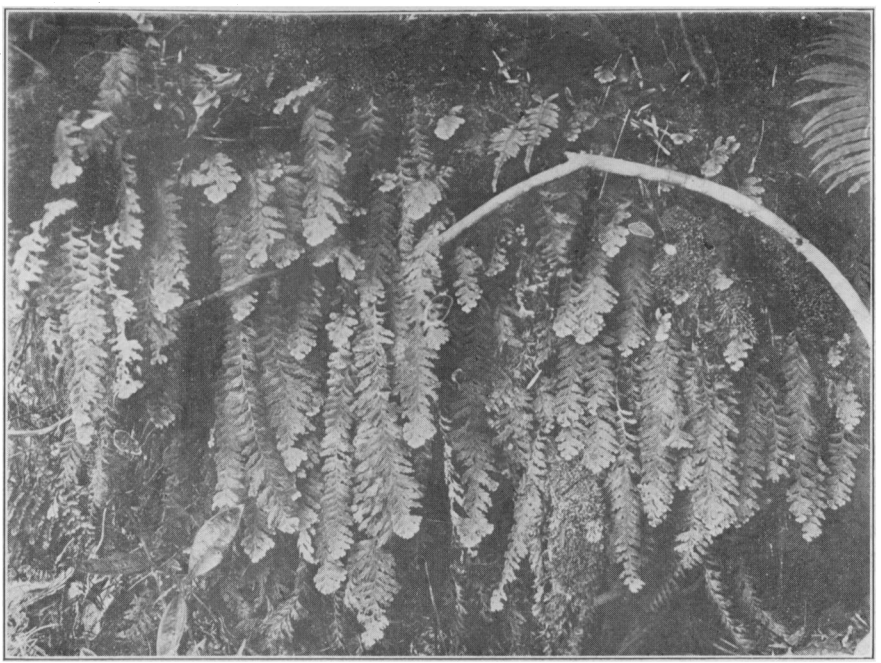
At the lowest elevations filmy ferns are to be sought on shaded rocks near waterfalls and on the trunks of trees near the ground in deep shade. Most of the forms found below 2000 feet have very small and relatively simple fronds. One of the simplest of these is *Trichomanes sphenoides*, which has nearly circular sessile fronds, seldom exceeding ½ inch in diameter. *Trichomanes reptans*, *T. polypodioides*, and *T. pusillum* belong to this simple type, while *T. muscoideum* has longer fronds, simple or pinnatifid, resembling those of our own *T. petersii* of Georgia and Alabama.

A very common type of *Trichomanes*, which is closely like several species of *Hymenophyllum*, may conveniently be alluded to as the "generalized type." It has bipinnate, stipitate, glabrous fronds, in which the ultimate segments are of a uniform width of about one-sixteenth of an inch. This type is erect in growth, may be terrestrial or epiphytic, and has fronds from

2 to 6 inches in length. *T. Krausii* may be regarded as a transition from the simple type to the generalized. These two types hold sway from 1000 to 4000 feet in elevation, the latter being represented by *T. pyxidiferum*, *T. arbuscula*, *H. polyanthos*, *H. tunbridgense*, *H. fucoides*, and *H. catherinae*. The character of the frond diverges from the generalized type toward both a finer and a coarser segmentation. *H. axillare* and *H. crispum* are close to the generalized type but rather finely dissected, the ultimate segments of the latter being elaborately frilled. *T. tenerum* has narrow elongated fronds with very narrow segments, and grows only as a pendent epiphyte on the trunks of tree ferns. The most finely dissected of all *Trichomanes* is *T. trichoideum*, which has fronds from 2 to 3 inches in length, with fine capillary segments less than 1/32 inch in diameter. One of the most striking sights of the rain-forest is a tree-fern trunk covered with an airy mat of *Trichomanes trichoideum*, from which glisten a thousand drops of water held in the forkings of the fronds.

The finely dissected filmy ferns are outnumbered, at least in Jamaica, by those in which the ultimate segments are wider than in the generalized type. Hardly any of these have as large areas of unbroken leaf surface as may be found in the simple types first mentioned, but all are much larger than the simple types, so that some of them have a total area of as much as 6 square inches. This is true of *T. crispum*, a simply pinnate form growing erect and stiff on the ground or as a low epiphyte. The pendent *H. asplenioides* has glabrous fronds of simple form and sinuate outline with rather large areas of solid leaf surface, and there are also large areas in *T. alatum* and *T. crinitum*.

In the majority of the more coarsely segmented fronds, and in some of the generalized type, we have a more or less pronounced hairiness. This results in a brownish



COLONY OF HYMENOPHYLLUM SERICEUM EPIPHYTIC ON A HORIZONTAL LIMB

color, sometimes in a silky lustre, and is of great importance in helping to maintain a film of water over the surface of the frond, as well as in protecting it from danger of extreme desiccation. The climbing *T. radicans* (very close to *T. boschianum* of Florida) is the largest of the Jamaican filmy ferns, its fronds sometimes measuring 15 inches in length. In every feature of habit and appearance it is closely matched by *T. scandens* which is, however, so hairy as to be distinguishable from *T. radicans* at a distance of twenty feet. There are other cases of closely similar species, which differ chiefly in one being glabrous and the other hairy, as *H. polyanthos* and *H. ciliatum*.

In the Jamaican series of ferns hairiness is much more common in *Hymenophyllum* than it is in *Trichomanes*. All of the very hairy ferns are epiphytes, and without exception their fronds are limp and pendent. In *H. sericeum* the fronds continue to grow at the apex, while the oldest pinnae blacken and die. The golden brown and densely pubescent fronds of this form are a common sight in the rain-forest, hanging from moss-covered limbs (see plate 4). The hairy pendent species are found only in the very moist mountain forests above 4000 feet. Common among them are *H. lanatum*, with small simply pinnate fronds, *H. lineare*, *H. hirsutum*, and *T. lucens*, a beautiful form in which the fronds are both hairy and crispate. The lower side of a leaning trunk may often be found with a uniform covering of *H. lanatum* or *H. lineare*, each frond pointing exactly downward, and often dry when everything else in the forest is wet.

One of the most striking things about the filmy ferns is the ability of many of the species to grow as epiphytes more than half way from the ground to the canopy of of the forest, and in other relatively dry situations. In order to realize the difference between the environ-

mental conditions on the floor of the rain-forest and in the tree tops one has only to contrast the large thin leaves of the terrestrial herbaceous plants with the small leathery leaves of the trees themselves. The shade, moisture and stillness of the forest floor form an environment well suited to such plants as the filmy ferns. It is surprising to find that they have emerged from these conditions and are to be found where the atmosphere is drier, where there is more wind and where they may even be struck at times by the rays of the sun. In spite of the hairy coatings that make it easier for them to live in relatively arid locations, they have in the main become adapted to drier conditions by the ability of their cells to lose much of their water for short periods without fatal results. This is much the same line of physiological evolution that has been followed by the desert species of *Cheilanthes* and *Notholaena*. These plants have retained all of the morphological features and most of the anatomical ones to be found in their congeners of moister climates. By means of an adaptation which is physiological rather than anatomical, these desert ferns are able to live under nearly the same conditions as the cacti, with their elaborate structural features for meeting conditions of drought.

In spite of the great diversity exhibited by the ferns of the world, we must regard them as having been conservative from an evolutionary standpoint, when we contrast them with flowering plants.

TUCSON, ARIZONA.

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## My Experiences with a Fern Garden

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In 1908, while living in Clay County, Kansas, I found a colony of *Woodsia obtusa* growing on the eastern and northern exposure of what is called in Kansas a